Agenda for the HENEX 65% Design Review

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1. Opening (Tina Back, tinaback@llnl.gov)
2. Design Overview (John Seely, john.seely@nrl.navy.mil)
3. Mechanical Design (Layne Marlin, lmarlin@ssd5.nrl.navy.mil)
4. Optical Design (Larry Hudson, larry.hudson@nist.gov)
5. Electronic Design (Rob Atkin,ratkin@tigerinnovations.com)
6. Interface/Sensor (Glenn Holland, gholland@ssd5.nrl.navy.mil)
7. Project Schedule (Perry Bell, bell11.llnl.gov)

Questions/comments: Please refer to presentation number 7.

Total cost breakdown with calibration and contingency

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Diagnostic:	Static survey spectrometer
Acronym:	HENEX
Primary mission:	Survey spectroscopy over a large spectral range.
Secondary mission:	Conversion efficiency measurements and qualification of multi-keV source characteristics

Responsible Lab:	LLNL
Responsible Engineer:	Perry Bell
Responsible Scientist:	Tina Back
Responsible Expert Group(s):	X-ray Spectroscopy

	First use on NIF(M6)	cility acceptance(M8)
First article:	01-Jan-04	01-Jan-04
	01-Jan-04	01-Jan-04

Comments: This diagnostic design fabrication and installation has been contracted to the space sciences division of Navel Research lab

(actual) (actual) all costs in $K as spent

Item	Effort (FTE)	Other contributors	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	Totals
Management	0.9	Travel to NRL	3	40	40	40	41	19	0	0	0	0	**183**
Scientist support	0.2		2	0	0	0	12	18	0	0	0	0	**32**
Design (M0 - M3)	0.2		11	13	0	0	0	0	0	0	0	0	**24**
Procurement	0.0	NRL design,CCD's, Controls system, crystals and mounting hardware	172	540	343	0	352	95	0	0	0	0	**1,502**
Assembly (M4a)	0.0	There are none as this is part of the NRL contract	0	0	0	0	0	0	0	0	0	0	**0**
Calibration and Testing (M4b)	0.1	Wavelength calibration included in contract	0	0	0	13	0	0	0	0	0	0	**13**
Facility modifications	0.0	None	0	0	0	0	0	0	0	0	0	0	**0**
Installation & Integration (M5 & M6)	0.2	TES provides some integration effort to assist NRL	0	0	0	15	14	0	0	0	0	0	**29**
Operation on NIF prior to acceptance (M7 & M8)	1.3	Replacement filters or crystals not included	0	0	0	0	139	63	0	0	0	0	**202**
Total FTEs:	**2.8**	**Total k$:**	**188**	**593**	**383**	**68**	**558**	**195**	**0**	**0**	**0**	**0**	**1,985**
Contingency:	assumes 20%				77	14	112	39	0	0	0	0	**241**
Total FTEs w/contingency:	**3.3**	**Total k$ w/cont.:**	**188**	**593**	**460**	**82**	**670**	**234**	**0**	**0**	**0**	**0**	**2,226**

Supporting technology development:	A prototype was fielded by NRL under contract by LLE
Equipment re-use:	There is no equipment reuse on this desigr
Integration into facility by TES or other:	We are assuming that TES will provide a DIM, timing trigger signal and a Front end processor
Alignment capabilities provided by the facility:	DIM opposing port alignment system
Calibration and test facilities:	The instrument will come with a simple wavelenght calibration. To meet the secondary mission the insturment will need a full calibration which will be an additional cost

LLNL labor breakdown

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	First use on NIF(M6)	acceptance(M8)
First article:	30DEC03*	3/16/2009

Comments: This diagnostic design fabrication and installation has been contracted to the space sciences division of Navel Research lab

(actual) (actual) all costs in FTEs

Item	Labor categories	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	Totals
Management	.45 PH, .45 MA,	0.0	0.2	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	**0.9**
Scientist support		0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	**0.2**
Design (M0 - M3)	.05 SE, .06 EE, .01 PH, .02 ED, .02 MD, .06 CO,	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.2**
Procurement		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Assembly (M4a)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Calibration and Testing (M4b)	.11 MT,	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**
Facility modifications	N/A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Installation & Integration (M5 & M6)	.02 EE, .04 MT, .16 ET, .01 MA,	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	**0.2**
Operation on NIF prior to acceptance (M7 & M8)	.14 PH, .79 ET, .35 MA,	0.0	0.0	0.0	0.0	0.9	0.4	0.0	0.0	0.0	0.0	**1.3**
Totals		**0.1**	**0.3**	**0.2**	**0.4**	**1.2**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**2.8**
Contingency	assumes 20%			0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.0	**0.5**
Total inc. contingency		**0.1**	**0.3**	**0.2**	**0.5**	**1.5**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**3.3**

NRL contract cost breakdown

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	CONCEPTUAL DESIGN FY00 (6 mos.)	CAD DESIGN & PROCUREMENTS FY01 (6 mos.)	FABRICATION FY01 (6 mos.)	ASSEMBLY & TESTING FY02 (3 mos.)	EXPERIMENTS AT LLE FY02 (3 mo.)	TOTAL 24 mos.
FUNCTION						
PI (J. Seely)	20	10	10	10	10	60
Co PI (R. Deslattes)	40	10		50	10	110
Proj Scientist (C. Brown)	10	10		10	10	40
Proj Engineer (L. Marlin)	10	20	20	10		60
INSTRUMENT						
Mechanical Tech. (G. Holland)	10	10	10	20	20	70
Software Eng. (R. Feldman)	20	20		20	10	70
Electrical Eng. (J. Moser)	20	20		20		60
Optical Scientist (L. Hudson)	20	10	30	50		110
Optical Tech. (NIST)		10	20	20		50
Quality Assurance (J. Batterton)		10				10
TOTAL BY QUARTER	150	130	90	210	60	640
HARDWARE						
Crystals and mounts		30				30
Spectrometer boxes			40			40
Instrument structure and shielding			35			35
8 CCDs,mounts,cabling,phosphors	20	140				160
Computer control & DAS		60				60
Software tools		6				6
Validation hardware and x-ray source				75		75
TOTAL BY QUARTER	20	236	75	75	0	406
TRAVEL AND DELIVERY						
Travel to LLNL (4 RT, 2 days each)	2	2				4
Travel to LLE (4 RT, 1 week each)					4	4
Shipping container (1 instrument)					1	1
TOTAL BY QUARTER	2	2	0	0	5	9
TOTAL COST	**172**	**368**	**165**	**285**	**65**	**1055**

Milestone schedule

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Schedule & milestones (First article)	Milestone	FY00	FY01	FY02	FY03	FY04	FY05
Requirements accepted by JCDT	**M0**						
Conceptual Design Review accepted by JCDT	**M1**		Dec-00				
Engineering 65% Design Review accepted by JCDT	**M2**		Apr-01				
Engineering 100% Design Review accepted by JCDT	**M3**		Sep-01				
Assembly and benchtesting complete	**M4a**			Sep-02			
Functional testing complete	**M4b**				May-03		
Dry run review	**M5**				Sep-03		
First use on NIF (secondary diagnostic)	**M6**						
Functional operation on NIF (primary diagnostic)	**M7**					Jun-04	
Accepted by facility	**M8**						Mar-05

Integrated Project Schedule with up dates

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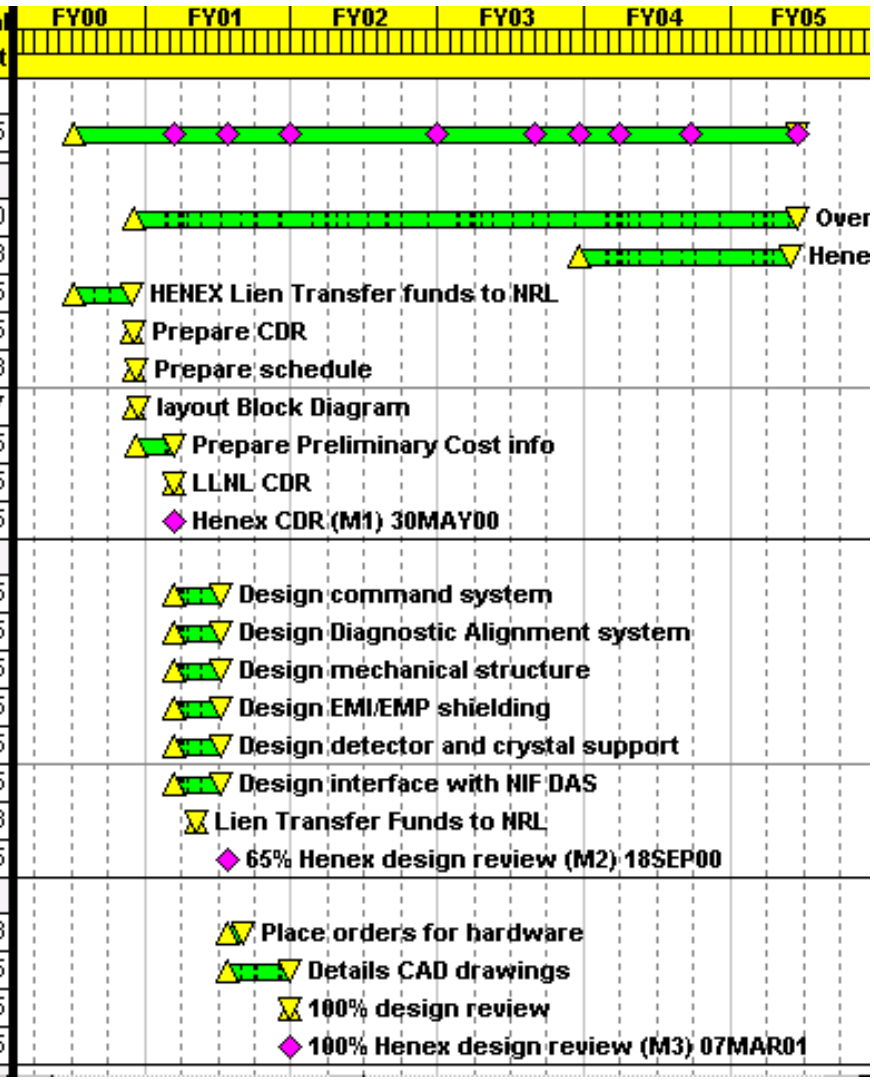
Activity Description	Orig Dur	Early Start	Early Finish	Total Float
2.10.04.03.05 X-RAY SPECTROMETER (HENEX) 1 EA				
	1,230	05APR00	15MAR05	1,205
2.10.04.03.05.01 REQUIREMENTS DEFINITION				
Oversite of Project	1,125	05SEP00	15MAR05	40
Henex floor space 10 ft x 10 ft	360	19SEP03	03MAR05	1,213
HENEX Lien Transfer funds to NRL	102	05APR00	29AUG00	45
Prepare CDR	5	30AUG00	06SEP00	45
Prepare schedule	2	07SEP00	08SEP00	98
layout Block Diagram	4	07SEP00	12SEP00	107
Prepare Preliminary Cost info	65	08SEP00	11DEC00	45
LLNL CDR	1	12DEC00	12DEC00	45
Henex CDR (M1) 30MAY00	0		12DEC00	45
2.10.04.03.05.02 65% DESIGN				
Design command system	77	13DEC00	06APR01	45
Design Diagnostic Alignment system	77	13DEC00	06APR01	55
Design mechanical structure	77	13DEC00	06APR01	55
Design EMI/EMP shielding	77	13DEC00	06APR01	55
Design detector and crystal support	77	13DEC00	06APR01	55
Design interface with NIF DAS	77	13DEC00	06APR01	55
Lien Transfer Funds to NRL	1	05FEB01	05FEB01	98
65% Henex design review (M2) 18SEP00	0		23APR01	45
2.10.04.03.05.03 100% DESIGN				
Place orders for hardware	30	24APR01	05JUN01	123
Details CAD drawings	108	24APR01	25SEP01	45
100% design review	2	26SEP01	27SEP01	45
100% Henex design review (M3) 07MAR01	0		27SEP01	45



Integrated Project Schedule (continued)

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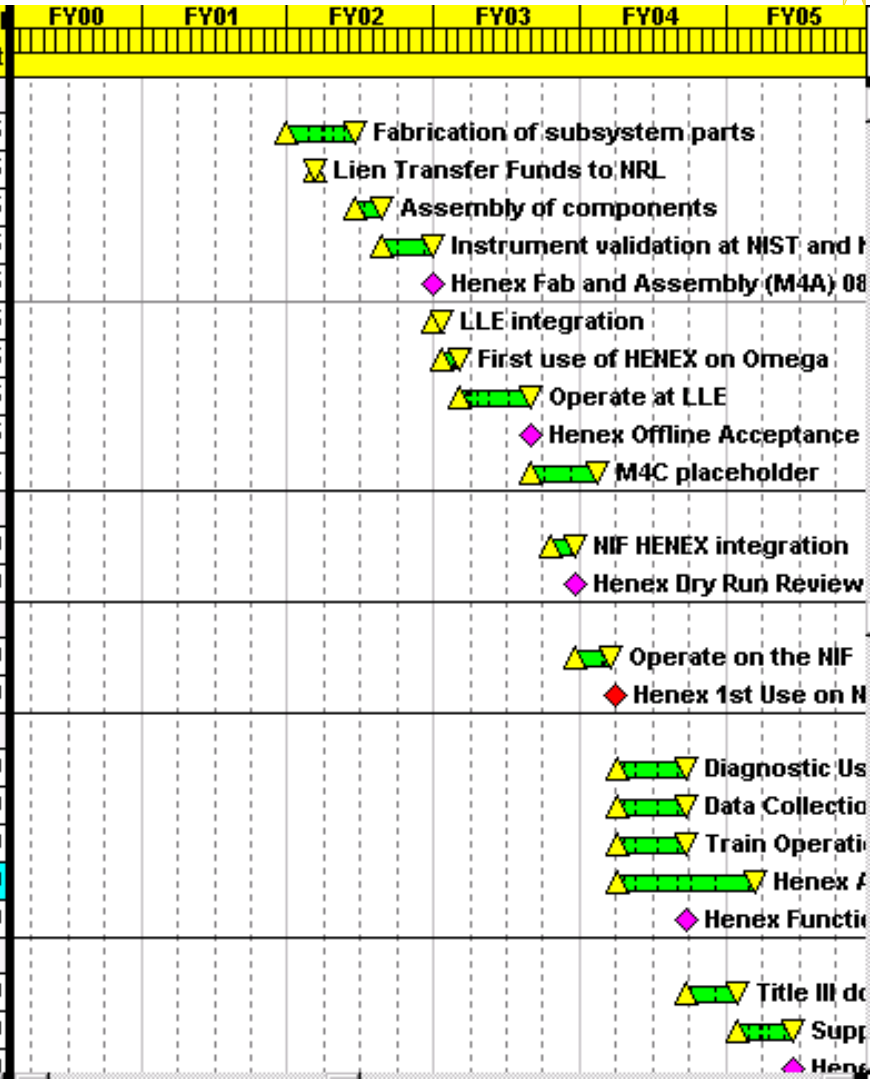
Activity Description	Orig Dur	Early Start	Early Finish	Total Float
2.10.04.03.05.04 FAB & OFFLINE ACCEPTANCE				
Fabrication of subsystem parts	115	28SEP01	19MAR02	45
Lien Transfer Funds to NRL	1	11DEC01	11DEC01	155
Assembly of components	46	20MAR02	23MAY02	45
Instrument validation at NIST and NRL	90	24MAY02	01OCT02	45
Henex Fab and Assembly (M4A) 08MAY02	0		01OCT02	45
LLE integration	14	02OCT02	21OCT02	45
First use of HENEX on Omega	30	22OCT02	04DEC02	45
Operate at LLE	120	05DEC02	02JUN03	45
Henex Offline Acceptance Tests (M4B)	0		02JUN03	85
M4C placeholder	115	03JUN03	12NOV03	1,534
2.10.04.03.05.05 DRY RUN REVIEW				
NIF HENEX integration	40	24JUL03	18SEP03	9
Henex Dry Run Review (M5) 05MAR03	0		18SEP03	9
2.10.04.03.05.06 1ST USE ON NIF				
Operate on the NIF	60	19SEP03	15DEC03	9
Henex 1st Use on NIF (M6) 30MAY03	0		30DEC03*	0
2.10.04.03.05.07 HENEX FUNCTIONAL OPERATION				
Diagnostic Used as a Tertiary on Shots	120	02JAN04	23JUN04	40
Data Collection and Analysis	120	02JAN04	23JUN04	40
Train Operation Staff	120	02JAN04	23JUN04	40
Henex Absolute calibration and station	240	02JAN04	14DEC04	99
Henex Functional Operation (M7) 18NOV03	0		23JUN04	40
2.10.04.03.05.08 HENEX FACILITY ACCEPTANCE				
Title III documentation	90	24JUN04	29OCT04	40
Support for Secondary or Primary Diagnostic	89	01NOV04	15MAR05	40
Henex Facility Accept Rview (M8) 10AUG04	0		15MAR05	40



What's not included in the current cost allocation

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Estimated operations/replacement costs (not included in the project budget):	$K Each	Number	$K Total
Replacement frontend filters	1	5	5
Replacement pre-mounted crystal	10	5	50
Replacement fiber optic cables	2	2	2
Backup spare sensor assembly with scintillator & filter	20	5	100
Drive Electronics complete replacement	70	1	70
Diagnostic Interface Unit complete replacement	23	1	23
			250
Possible add-ons (not included in the project budget):			
Film assemblies (5 to mount on HENEX and 5 with pre-loaded film for the next shot)	6	10	60
Crystal characterization (topographs,rocking curves,reflectivity)	3	5	15
Extend transmission crystal range to 60 keV	50	1	50
Implement additional CMOS sensors for x-ray & neutron dose measurements	50	2	100
Retrofit CMOS sensor electronics to have adjustable gain (software controlled)	20	1	20
Add Sleep Mode to Drive Electronics (would extend battery lifetime)	20	1	20
Upgrade battery capacity (would extend lifetime)	30	1	30
10-diode array for time-dependent flux measurements on transmission crystal cha	25	2	50
Imbedded fast digitizing electronics	200	1	200
Multi-channel fiber optic cable/feedthrough for diode channels	175	1	175
			720

Conclusions and comments

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The Henex project is meeting schedule, scope and cost

The project is a good example of out source contract for diagnostics

There are additions that can be add to the basic instrument if desired

Being the first diagnostic in series of diagnostics to come we are faced with defining the guidelines and interface issues with the NIF project.

- Many guidelines are incomplete or conflicting
- Not relevant to the diagnostic developer

We are moving from a R&D mode to more of an under ground test environment (Shot cost driven Nova/Omega 10k Vs. NIF 100k)

We have discover that many things are over looked.

- Project interface is costly
- Documentation requirements are not defined
- NIF shot sequencing is not well understood